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(54) "Sink-float" separation of plastics from waste material

(57) Low density plastics is separated from waste material obtained when dressing scrap accumulators by a sink-float process. The floating material may comprise polyethylene and polypropylene, and the sinking material may comprise hard rubber, polystyrene, PVC, glass and lead components.

The material which sinks is tumbled by a rotating conveyor 12 while it is being transported to an outlet opening 18 in the bottom of the separating vessel 11. —

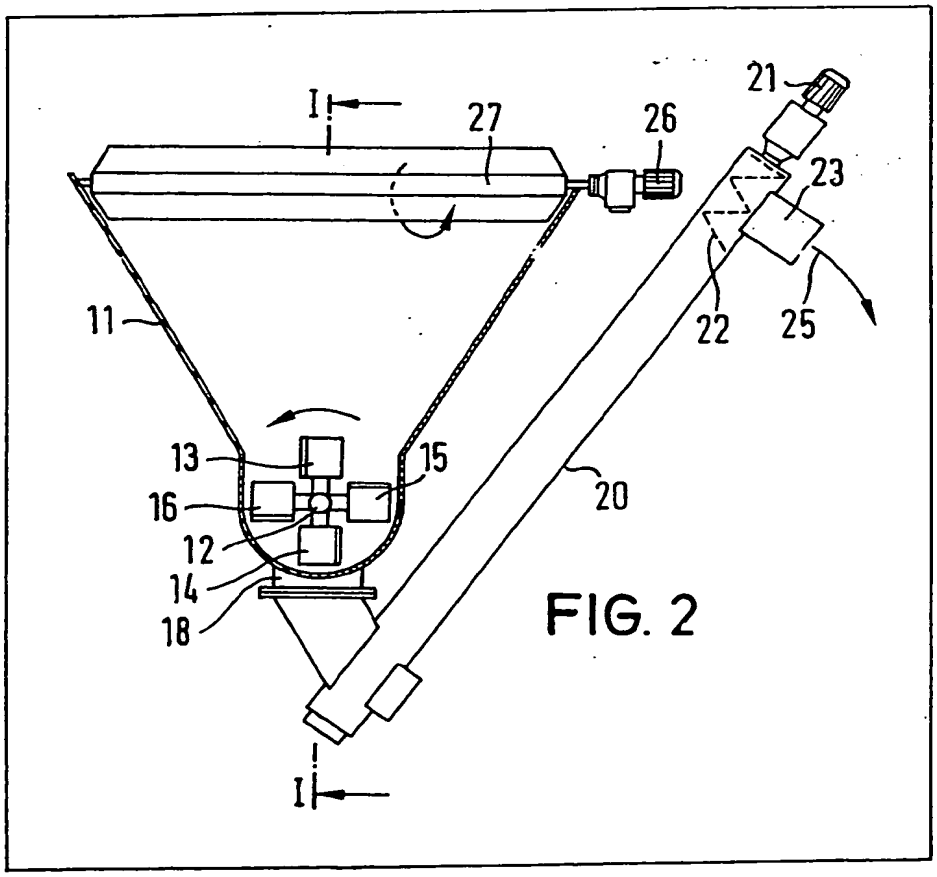

FIG. 2

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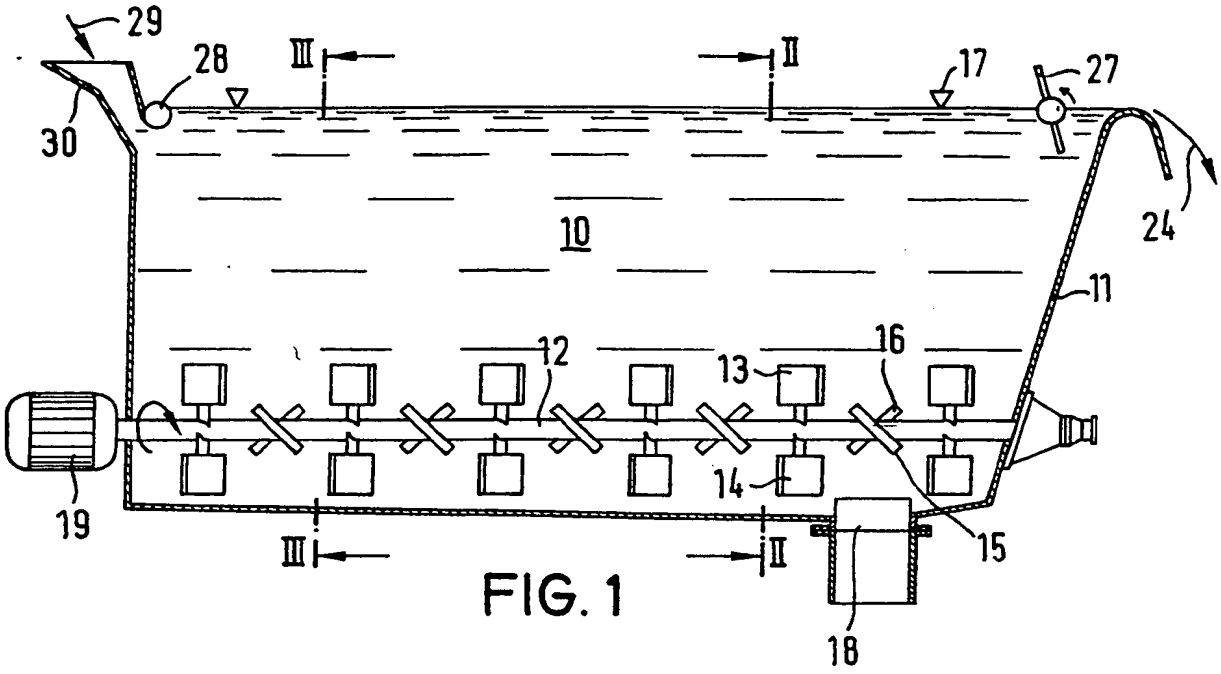

FIG. 1

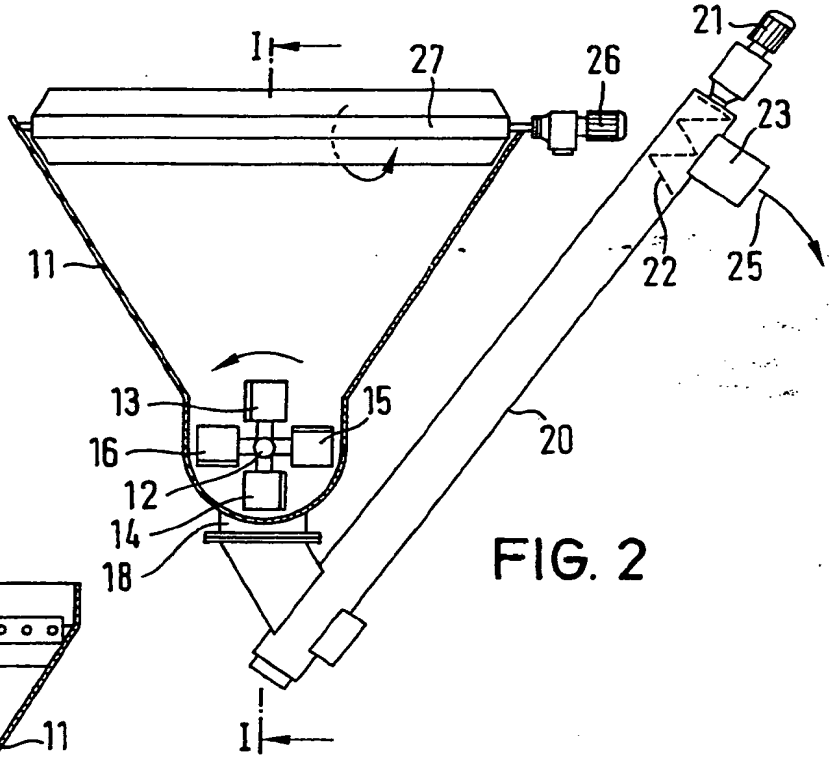

FIG. 2

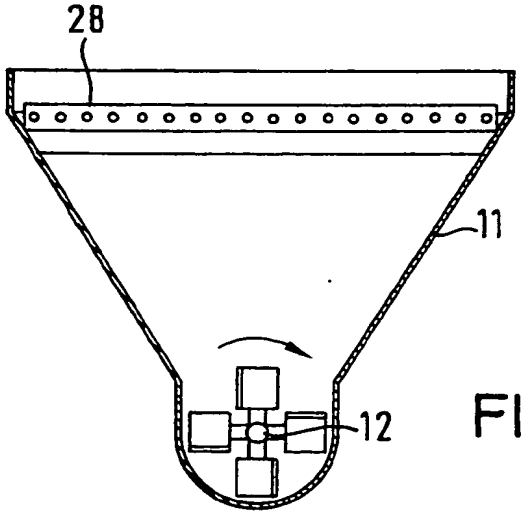

FIG. 3

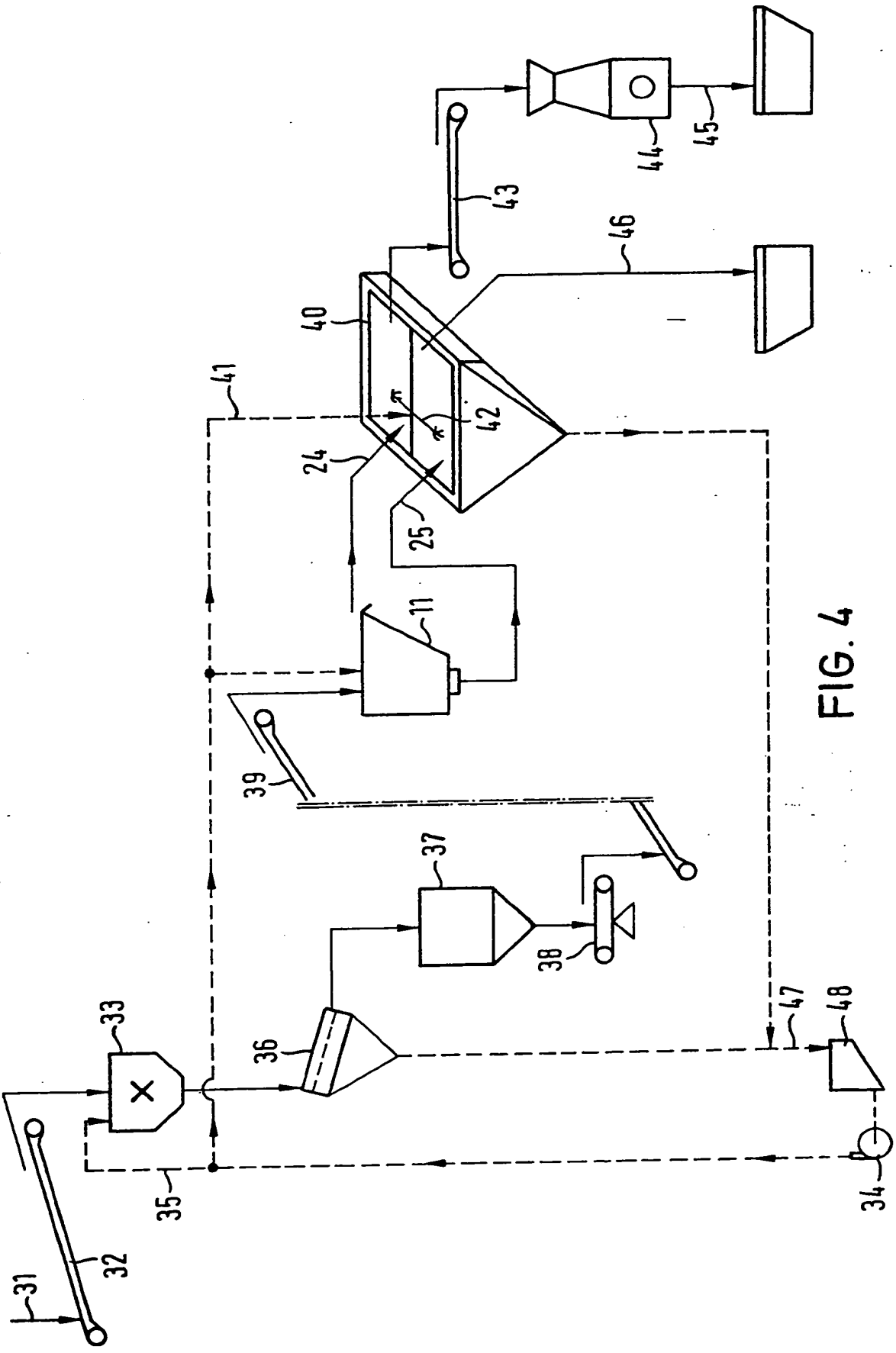

FIG. 4

SPECIFICATION

A method of and apparatus for extracting specific plastics from the waste material obtained when dressing scrap accumulators

The invention relates to a method of extracting low density plastics such as polyethylene and polypropylene, from the waste material obtained when dressing scrap accumulators. Moreover, the invention relates to an apparatus suitable for carrying out this method.

When processing scrap accumulators, the lead-containing components such as metallic lead, lead oxide and lead sulphate are extrated as valuable products while the accumulator housing material and the separators located inside the accumulators are obtained as a waste product which has to be disposed of (German Auslegeschrift No. 1 224 935). The accumulator housing material frequently comprises hard rubber (known by the trade mark "Ebonite"), polystyrene, polyethylene or polypropylene. The separators essentially comprise PVC (Polyvinylchloride) and there are also separators comprising hard or bakelised paper.

Besides these materials, pieces of the positive plate of some accumulators are also present in the waste product obtained when preparing accumulator scrap and these pieces of the positive plates comprise glass fibres and/or plastics fibres and are partially filled with lead oxide. In view of their low density, their viscosity and their resistance to sulphuric acid, polyethylene (PE) and polypropylene (PP) are being increasingly used as material for the housings or casings of accumulators. The plastics PE and PP, as mentioned, belong chemically to the polyolefin group and are obtained from crude oil. Due to the increase in the price of crude oil, considerable importance is now being put on recycling PE and PP from waste products.

The invention seeks to create a method and an apparatus whereby it is possible to extract valuable low density plastics efficiently from the waste material obtained when processing scrap accumulators, which plastics in the past had been discarded.

According to a first aspect of the invention, there is provided a method of extracting low density plastics from the waste material obtained when dressing scrap accumulators, wherein the waste material is separated in a sink-float process according to specific gravity into floating material which comprises the low density plastics and sinking material which comprises higher density materials than the said low density plastics.

Preferably the low density plastics comprise material comprising polyethylene (PE) and polypropylene (PP) and the higher density materials include one or more of polystyrene, PVC, glass, glass-fibre and lead components.

Since the plastics PE and PP have a density of between 0.91 and 0.96 g/cm^3, depending on how they were produced, they may be obtained as floating material by the sink-float process when using water (having a density of 1.0 g/cm^3) as the separating agent, whereas polystyrene having a density of 1.05 g/cm^3, hard rubber (Ebonite) having a density of approximately 1.39 to 1.40 g/cm^3 and the PVC separators having a density of approximately 1.30 g/cm^3 fall to the bottom as heavy material. The part of the waste material which sinks may have some PE and PP initially retained therewith because, for example, knots of plastics fibres prevent the specifically lighter materials from floating. This part may be tumbled continuously and at the same time transported in the liquid separating agent, e.g. water from the sink-float separating process, so that the PE and PP materials which have been carried along thereby are released and are able to float up to the surface. In addition, the lead components which are still incorporated and caught up in the housing material of the accumulators and in the separators may be released. In this way the waste material may be properly sorted.

According to a second aspect of the invention there is provided apparatus for extracting low density plastics from the waste material obtained when dressing scrap accumulators, wherein a float-sink device is provided for separating the waste material according to specific gravity into floating material which comprises the low density plastics and sinking material which comprises higher density materials than the said low density plastics. A crushing device may be provided in which the waste material is crushed to a grain size of less than 100 mm and whose outlet is connected to the sink float device. The sink-float device may comprise a container for liquid, a rotating conveyor element for tumbling and transporting the sinking material to an outlet opening arranged in the base region of the container and an outlet element for extracting the floating material may be arranged in the upper edge region thereof.

The invention will now be described in greater detail, by way of example, with reference to the schematic drawings, in which:—

Figure 1 shows a sink-float sorting device for use in the method in accordance with the invention in a longitudinal section along the line I—I of Figure 2;

Figure 2 shows a section of the device of Figure 1 taken along the line II—II;

Figure 3 shows a section of the device of Figure 1 taken along the line III—III, and

Figure 4 shows the flow chart of a method in accordance with the invention.

A set sorting device 10 shown in Figure 1 forms the main apparatus for carrying out the method. It comprises a container 11 which is cylindrical at its base and broadens out in its cross section towards the top. A shaft 12 on which individual vane like conveyor elements 13, 14, 15, 16 are helically arranged is located in the cylindrical part. The conveyor elements are arranged to be inclined so that when the shaft 12 of a drive motor 19 is rotated they tumble the material sinking to the

bottom of container 11 and immersed in the water 17 and, at the same time, transport the sinking material towards an outlet 18, located at the base of the container 11. The outlet opening 18 for the sinking material is connected to a rise pipe 20 which lies outside the water container 11 and is connected to the water container 11 by a syphon line connection while a conveyor element, e.g. a screw conveyor 22 driven by the motor 21, is arranged in the rise pipe 20 and conveys the sinking material in the rise pipe 20 upwardly to an outlet opening 23 which is arranged approximately at the height of the liquid level 17 in the sink-float sorting device 11 with an overflow 24 for the floating material. Therefore as the sinking material is extracted with the aid of the screw conveyor 22, the drive of the column of liquid in the rise pipe 20 is utilised on the one hand and on the other hand there is not very much liquid lost with the outlet of the sinking material 25.

Outlet of the floating material 24 from the sorting device 11 is implemented by a paddle 27 driven by a geared motor 26. In order to guide the floating material PE and PP to the paddle 27, a sprinkling device 28 is so arranged at the surface 17 of the water that the sprinkled water guides the floating material towards the paddle 27. This could also be achieved by means of several paddles 27 driven by v-belts and located at the surface 17 of the container 11.

The waste material 29 which is obtained when dressing scrap accumulators is supplied to the sorting device 11 by a funnel 30 arranged behind the sprinkling device 28. As the heavier material sinks it takes a part of the PE and PP down with it, included in the sinking material. By tumbling the material at the base of the container 11, these entrained proportions of PE and PP can be released and are able to float back to the surface of the water.

In order to make it possible to convey the sinking material in the sorting device 11 and in the rise pipe 20 which follows without any difficulty on the one hand and on the other hand to release the lead components caught up and included in the separators and in the accumulator casing material, the waste material to be treated should be present in a granulation of less than 100 mm, or preferably less than 80 mm.

The waste feed material 29 consists of a mixture of metal elements, various plastics, plastics fibres, glass particles etc. Therefore there are difficulties in crushing this heterogeneous mixture in cutting machines which have been developed for plastics. It has become clear that this mixture is easily crushed in a hammer mill. In order that the plastics should be more easily crushed this process is carried out when the plastics are wet, water serving as the cooling medium for dissipating heat due to crushing and at the same time as a slurry medium.

Figure 4 shows schematically the method of obtaining PE and PP from the waste material 31 obtained when dressing old accumulators, this waste material being supplied via a belt conveyor 32 to a hammer mill 33. Water is introduced into the hammer mill 33 at the same time, and is supplied via the pump 34 and the pipe 35 shown in broken lines. The crushed waste material is passed through a de-watering sieve 36 into an intermediate hopper 37. The waste material is supplied in metered amounts via a belt weighing and metering device 38 and a belt conveyor 39 to the sorting device 11 shown in greater detail in figures 1 to 3. The cleaned PE and PP mixture 24 and the waste products obtained as sinking material 25 are de-watered in a centrally partitioned sieve 40 which may be equipped with a sprinkling device 42 connected to a water supply line 41.

The cleaned PE and PP mixture is supplied to a cutting mill 44 by a belt conveyor 43 and is crushed there to a grain size of less 7 mm. The crushed product 45 is suitable for feeding to an extruder for example in order to produce plastics granulate from the product.

The waste material 46 of the method of figure 4 may be further sorted in a second sink-float separation process (not shown) with a heavy slurry having a density greater than 1.0. The heavy slurry may be produced for example by using magnetite or barium sulphate suspended in water.

Essentially the following advantages are achieved by the invention:

Simple and clean separation of PE and PP from the waste material which is obtained when processing scrap accumulators can be achieved. Normally water is used as a separating agent for the sorting device.

The sink-float separation process takes place at a grain size of the waste material of up to 100 mm. The waste material is tumbled satisfactorily with the aid of the conveyor element provided with inclined conveyor element members due to the downward movement of the sinking material. The water consumption is low because all of the process water is re-circulated through pipe 47, buffer container 48 and pump 34. The energy consumption is also low. Water which has already been used can also be utilised as the separating agent for the sorting process. PE and PP products 24 and the waste product 25 can be rinsed through the de-watering sieve 40 once again. As a result a clean PE and PP product is obtained for further processing and a waste product is obtained which is disposable and which has no soluble lead content. The sorting device may also be used as a sink-float device for sorting materials with a fairly high density by using a heavy slurry with a fairly high density in order to separate a floating material of higher density, and in this case the separating agent would have to be regenerated and recirculated.

CLAIMS

1. A method of extracting low density plastics from the waste material obtained when dressing scrap accumulators, wherein the waste material is separated in a sink-float process according to

specific gravity into floating material which comprises the low density plastics and sinking material which comprises high density materials than the said low density plastics.

2. A method according to claim 1, wherein the low density plastics comprise polyethylene and polypropylene.

3. A method according to claim 1 or 2, wherein the high density materials include one or more of hard rubber, polystyrene, PVC, glass and lead components.

4. A method according to claim 1, 2 or 3, wherein the part of the waste material which sinks is tumbled continuously in the liquid separating agent of the sink-float process and is conveyed at the same time.

5. A method according to any one of claims 1 to 4, wherein the waste material is crushed to a grain size of less than 100 mm before being introduced into the sink-float separation process.

6. A method according to claim 5, wherein the crushing process takes place in a hammer mill while wet in a flow of slurry.

7. A method according to any one of claims 1 to 5, wherein polyethylene and polypropylene are separated off as flotation material from the feed waste material in a first sink-float separation process using water as the separating medium; and wherein hard rubber, polystyrene and PVC are separated off in a second sink-float separation process with a heavy slurry having a density which is greater than 1 gm/cm^3 as the separated medium.

8. A method according to claim 7, wherein the slurry has a density of approximately 1.50 g/cm^3.

9. Apparatus for extracting low density plastics from the waste material obtained when dressing scrap accumulators, wherein a float-sink device is provided for separating the waste material according to specific gravity into floating material which comprises the low density plastics and sinking material which comprises higher density materials than the said low density plastics.

10. An apparatus according to claim 9, wherein a crushing device is provided, the outlet of which is connected to the sink-float sorting device which comprises a liquid container, a rotating conveyor element for tumbling and transporting the sinking material to an outlet opening arranged in the base region of the liquid container and an outlet element for outlet of the floating material arranged in the upper edge region of the liquid container.

11. Apparatus according to claim 10, wherein the outlet opening for the sinking material located at the base of the sink-float device is connected to a rise pipe by a syphon like connection connected to and lying outside the sink-float device, a conveyor element, is arranged in this rise pipe for conveying the sinking material upwardly to an outlet opening in the rise pipe this outlet opening being arranged approximately at the height of the liquid level of the liquid in the sink-float device with an overflow for the floating material.

12. Apparatus according to claim 10, wherein the conveyor element in the rise pipe comprises a screw conveyor or a bucket mechanism.

13. A method of extracting low density plastics materials from waste material from scrap accumulator dressing substantially as described herein with reference to the drawings.

14. Apparatus for extracting low density plastics from waste material from scrap accumulator dressing substantially as described herein with reference to the drawings.

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